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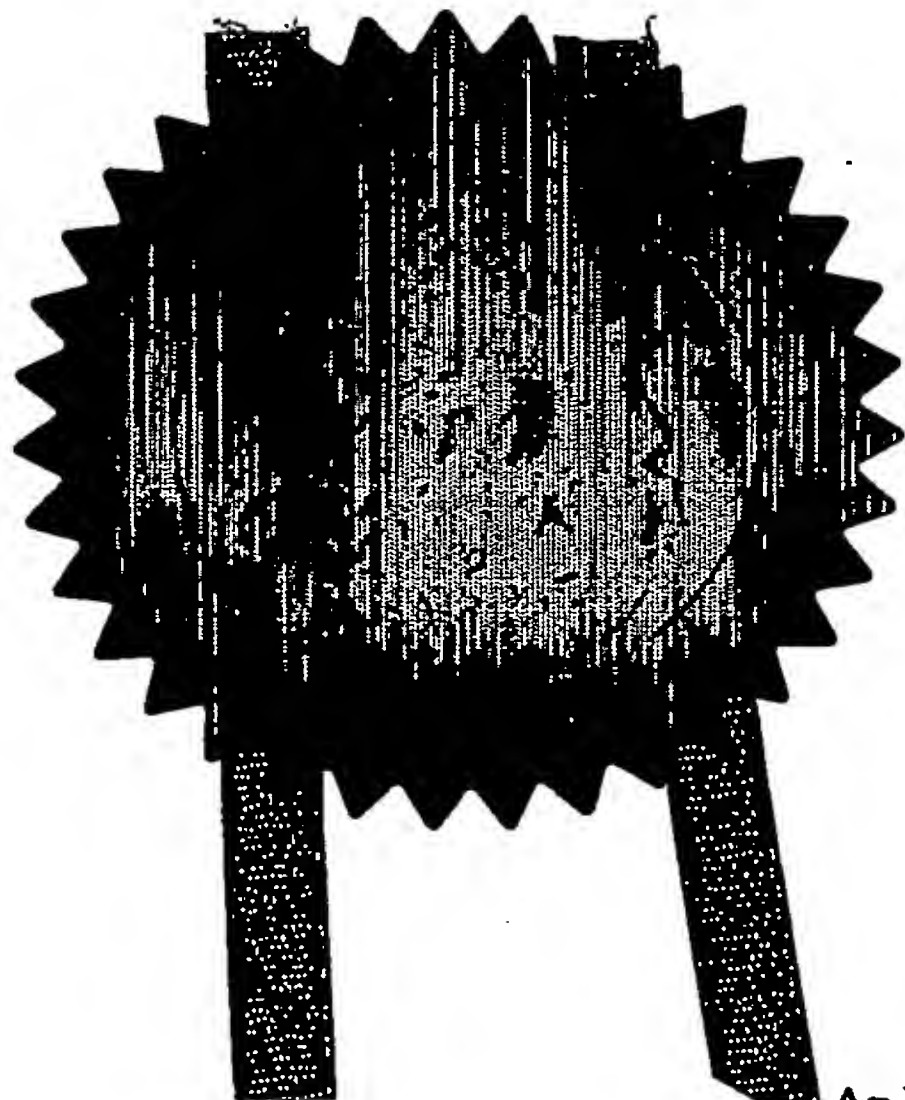
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The Patent Office

Cardiff Road
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1. Your reference 9651 GB JEB/VSB

2. Patent application number
(The Patent Office will fill in this part)

01 JUL 2003

0315384.8

3. Full name, address and postcode of the or of each applicant (underline all surnames)

International Technology Traders Limited
Unit 17 Village Farm Road
Village Farm Industrial Estate
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Mid-Glamorgan CF33 6BL

08665036001

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom.

4. Title of the invention ORGANIC WASTE DISPOSAL

5. Name of your agent (if you have one)

Abel & Imray

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

20 Red Lion Street
London
WC1R 4PQ
United Kingdom

Patents ADP number (if you know it)

174001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number
(if you know it)

Date of filing
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

Yes

- a) any applicant named in part 3 is not an inventor, or
 - b) there is an inventor who is not named as an applicant, or
 - c) any named applicant is a corporate body.
- See note (d))

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description 12

Claim(s) 3

Abstract

Drawing(s) 4 + 4 *SW*

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents (please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature *Abel and Imray*
Abel & Imray

Date *1/7/03*
1 July 2003

12. Name and daytime telephone number of person to contact in the United Kingdom

Victoria Bradford - 020 7242 9984

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ORGANIC WASTE DISPOSAL

The present invention relates to organic waste disposal. In particular, the present invention relates to a method and apparatus for organic waste disposal which converts wet organic waste into a powder.

The term "organic waste" is used throughout to mean waste which is predominantly food waste (animal and vegetable waste, cooked or raw) but may include, for example, paper waste and effluent screenings or effluent sludge and may also include a small amount of non-organic packaging (for example foil or plastic). In order for the waste to be termed organic waste, the proportion of packaging must be low (in general, less than 10% by weight of non renewable materials such as plastics and foils). Other waste, which includes a higher proportion of non-organic waste, is often termed general waste or municipal solid waste (MSW). Organic waste typically has a significantly higher water content than MSW.

MSW may be easily disposed of by burning but organic waste, typically having a water content of more than 40%, can be combusted or gasified more easily after drying. Without drying, such combustion requires high temperatures. This requires the addition of dried material or fuel which reduces the moisture content and allows combustion at a high temperature or gasification. However, a number of methods of disposing of organic waste are known. Such known methods include disposing in landfill sites, as animal feed, by rendering (particularly meat waste and animal by-

products), by composting or by digestion (particularly slurries).

However, several such methods of organic waste disposal are becoming less acceptable for a number of reasons. Firstly, there is concern over the environmental impact of waste disposal. It is not known whether landfill sites are having long term detrimental effects on the environment and, as the amount of waste increases, more and more landfill sites are required. There are increased legislation and planning restrictions limiting new sites, particularly those for disposal of food waste. In addition, there is concern over the potential dangers of feeding food waste to livestock.

There is also increasing pressure on industry to take responsibility for their own waste. This means that there are fewer routes available to industry to dispose of their waste safely and that waste disposal is becoming a more and more costly business.

One known system for disposal of organic waste is illustrated in Figure 1, which shows a known process vessel 10 in cross-section. The vessel comprises four channels 12. Each channel 12 has a cross section which is a segment of a circle. Typically, the arc of the circle, which forms the curved wall of the channel extends about an obtuse angle, typically around 150° of the circle. However, the angle could be 180° , so that the cross section is semi-circular or could be greater than 180° or less than 90° depending on the application. The vessel could comprise fewer or more channels and this will depend on the space available and

the amount of organic waste to be processed. Each channel 12 includes an axle 16 which rotates, each axle 16 mounting a number of paddles (not shown) or one or more helical blades (not shown), sometimes known as a ribbon mixer. The 5 channels are heated via a heat exchanger 14, so that the curved portions of each channel reach a high temperature (150° to 250°C in some applications).

10 The organic waste is deposited into the channels 12 and, as the paddles or blades rotate and the channel walls heat up, the physical structure of the organic waste is broken down which assists the process of removing water by evaporation. After a certain amount of time, the organic waste is entirely converted to dry organic particles and fibres as 15 well as shreds of the non-organic packaging. The material is then in the form of a powder or sand like material, which can be used as a fuel. This "bio-fuel" can be used in a number of applications.

20 This system avoids the need for landfill sites as well as avoiding the potential dangers associated with feeding food waste to livestock. However, there are several problems with known organic waste disposal systems which convert wet organic waste to a powder fuel.

25

One such problem is that, in order to heat the vessel so as to dry out the organic waste, fuel (generally oil or gas) is required and this must be imported on to the site. The fuel itself, as well as the fuel transport costs, both add 30 to the expense of the disposal.

An object of the present invention is to provide a method and apparatus for processing organic waste which avoids or mitigates the above-mentioned problem with known organic waste processors.

5

According to the invention there is provided a method for drying organic waste, comprising the steps of:

mixing and heating a first quantity of organic waste to form an organic powder;

10

converting a portion of the organic powder to heat a second quantity of organic waste.

15

Such a method, where the organic powder itself is used as a fuel to heat the organic waste, has several advantages. The system is self-heating: no fuel needs to be imported on site, which avoids a large expense and a potential hazard.

20

A major proportion of the available energy from the bio-fuel can be usefully used on site in any number of ways. The user can save money on input (by saving the costs which would be incurred to destroy their organic food waste) and can also generate money on output (by using the resulting energy in any of a number of ways). The entire unit can be accommodated on-site, which also reduces the costs of transporting the organic waste.

25

The organic powder may be converted by conventional combustion in air, or pyrolysis or gasification or by any other suitable conversion process.

30

The method may be carried out as a step by step process. In that case, in a first step, the first quantity of organic

waste is completely broken down to form organic powder. Then, in a second step, a second quantity of organic waste is mixed and heated by using a portion of the organic powder generated in the first step. The remaining organic powder may be exported off site or may be used on site (together with or separately from the selected portion of the organic powder). Then, in a third step, a third quantity of organic waste is mixed and heated by using a portion of the organic powder generated in the second step. Again, the remaining organic powder may be exported off site or may be used on site (together with or separately from the selected portion of the organic powder). And so, the step by step process continues.

Alternatively, the method may be carried out as a continuous process. In that case, as the organic powder is formed, an appropriate portion of it is continuously separated and used to heat more organic waste. The organic powder that is not required to heat the organic waste may be exported off site or may be used on site (together with or separately from the selected portion of the organic powder).

In either a step by step process or a continuous process, the organic powder which is not required to heat the organic waste can be used on site or off site. Heat generated can be used in a number of applications. For example, the heat may be used to generate electricity, hot water or steam or may be used for refrigeration.

The original organic waste will typically have a water content of more than about 40% by weight. Of course, it is possible for the organic waste to have a water content of less than about 40% by weight. The water content of the organic waste will depend on the particular composition of the organic waste.

It should be noted that, throughout the specification, the water content percentages or other content percentages (e.g. non-organic packaging) always refer to percentage by weight.

Preferably, the organic powder has a water content of about 10% by weight. Ultimately, the water content will depend upon the method of conveying the organic powder as a bio-fuel, its storage and its input to energy conversion equipment. It has been found that, with a water content of about 10% by weight, the powder is useful as a bio-fuel since the bio-fuel is physically stable, able to be transported as powder, compressed into briquettes, blown into cyclones and/or screw fed.

The step of mixing and heating the organic waste may be achieved by a known one-stage process. In that case, the organic waste is continuously heated and mixed until it eventually forms an organic powder which can be used as a bio-fuel. It passes through a number of phases: firstly, a high percentage water content phase where the organic waste can be heated extensively since the heat will result in water evaporation; secondly a mousse phase and then a thick paste phase where the mixing machinery must be very robust

and the vessel itself must be a strong structure; finally a powder phase with a reduced water content, where the powder can be heated extensively because of its large surface area and ease of mixing. The final result is powder bio-fuel.

5

Alternatively, the step of mixing and heating the organic waste may be achieved by any other process which converts organic waste into an organic powder by mixing and heating.

10 According to the invention, there is also provided apparatus for drying organic waste comprising:

a vessel for mixing and heating a first quantity of organic waste to form an organic powder;

15 a conversion unit for converting a portion of the organic powder to generate heat for heating a second quantity of organic waste.

In one embodiment, the conversion unit may be a combustion unit and the organic powder may be burned. The combustion
20 unit may be a combustion unit of a known type. In other embodiments, the conversion unit is adapted for pyrolysis or gasification.

Preferably, the apparatus further comprises a heat
25 exchanger, the heat exchanger using the heat generated by the conversion unit to heat the vessel. In one embodiment, hot gas generated in the conversion unit is pumped into the heat exchanger.

30 Preferably, the heat exchanger circulates hot gas beneath the vessel. In some embodiments, the heat exchanger circulates the hot gas through the vessel itself.

The vessel may comprise:

at least two elongate channels, each channel having a length and a substantially segment shaped cross-section;

5 and

an axle associated with each channel, each axle mounted for rotation about an axis parallel to the length of its respective channel, each axle mounting a plurality of mixing paddles or one or more helical blades.

10

As described above, the organic waste will typically have a water content of more than about 40% by weight but it is possible for the organic waste to have a water content of less than 40% by weight.

15

Preferably, the second organic powder has a water content of about 10% by weight. As described previously, it has been found that this percentage water content is advantageous if the second organic powder is to be used as

20

a bio-fuel.

It is intended that any features described above in relation to the method of the invention may also be incorporated into the apparatus of the invention and that
25 any features described above in relation to the apparatus of the invention may also be incorporate into the method of the invention.

An embodiment of the invention will now be described with
30 reference to the accompanying drawings of which:

Figure 1 is a cross-sectional view of a known process vessel;

5 Figure 2 is a schematic diagram showing circulation of organic waste in a process vessel;

Figure 3 is a schematic diagram of a heat exchanger; and

10 Figure 4 is a schematic diagram showing how the bio-fuel can be used to fuel the heat exchanger.

In the known process vessel shown in Figure 1, the amount of organic waste which can be processed per unit time will
15 depend, *inter alia*, on the number of channels, the dimensions of each channel, the type of organic waste, the temperature of each channel and the speed of rotation of the axles.

20 In one embodiment, each channel is 3 m long, with a radius of 0.4 m. In that case, each channel can accommodate up to 1 tonne of organic waste so that the whole process vessel can accommodate 4 tonnes of organic waste.

25 Adjacent channels 12 have axles mounted to rotate in opposite directions. The construction of the paddles and the axles means that organic waste moves, for example, from the edges to the centre of the first channel, over the lip into the adjacent second channel, from the centre to the
30 edges of the second channel, over the lip into the adjacent third channel and so on. Thus, the construction and

rotation of the axles 16 and paddles 18 ensures that the organic waste circulates through the entire process vessel 10 as shown by schematic diagram Figure 2. Figure 2 shows a four-channel process vessel 10 but the circulation system could, of course be applied to any number of channels 12. The efficient circulation means that the process vessel 10 can be used to full capacity, that the active heated surface area of the channels 12 is used as efficiently as possible and that the breakdown of all the organic waste occurs at a consistent speed throughout the volume of the organic waste i.e. it reduces the likelihood that some of the waste is completely broken down, while some remains close to its original un-broken down form.

As shown previously, the channels 12 are heated from beneath by a heat exchanger 14. A schematic diagram of the heat exchanger of the present invention is shown in Figure 3, in a process vessel comprising eight channels 12. Hot gas is pumped into the heat exchanger 14 at inlet 26 and into the lower section of the heat exchanger, which acts as a pressure balancing chamber to assist in maintaining an even flow of hot air. The hot gas passes over the base of the heat exchanger 14, which is provided with insulation 28, and over the furthest edge of the heating jacket 30. The hot gas then passes over the heating jacket 30 in the upper section adjacent the semi-cylindrical channel surfaces and eventually out of the heat exchanger 14 at outlet 32.

The heat exchanger 14 preferably provides an even heat transfer across the walls of the channels 12 so that there

is a uniform temperature distribution throughout the food channels. It has been found that the geometry of the heating jacket 30 has a significant effect on heat transfer. The geometry of the heating jacket 30 also has a significant effect on the velocity of the gas within the heat exchanger 14. By altering the peak heights of the deflection saddles of the heating jacket 30, the velocity and turbulence of the gas can be increased or decreased. Higher gas velocities will generate a turbulent flow field and increase heat transfer by breaking down the boundary layer against the wall of each channel 12, and this means an even heat transfer across the channels 12, whilst the temperature of the hot flue gas falls from the inlet to the outlet of the heat exchanger.

With the heat exchanger design shown in Figure 3 there is more even heat transfer and the gas inlet temperature may be reduced to within the range 600°C to 700°C. A lower inlet temperature and even heat transfer allows lower overall operating temperatures, fewer hotspots and less chance of charring of the organic waste.

Figure 4 is a schematic diagram showing how, according to an embodiment of the invention, the bio-fuel resulting from the drying process can be used for combustion to produce hot flue gas which can be used in the heat exchanger.

Organic waste (typically of 40% to 90% water) is deposited into the process vessel 10 as previously described. The drying process carried out in the process vessel may be a known one-stage process or any other process which can

convert organic waste into organic powder bio-fuel by heating. The process vessel 10 may consist of between 2 and 12 channels 12. As described, the result of the drying process is a bio-fuel in powder form (typically of 10% water). That bio-fuel is used in a combustion unit of a known type. When the bio-fuel is burned, the resulting hot air (typically 600°C to 1000°C) can be used in the heat exchanger 14 of the process vessel 10 to heat the process vessel 10 for the next batch of organic waste being processed. The remaining energy can be exported off-site and can be used in any number of ways, for example to generate electricity, hot water or steam or for refrigeration.

15 An example of this aspect of the invention is given in the following example. 1 tonne of organic waste is deposited into the process vessel. The organic waste is 50% solid waste (500 kg) and 50% water (500 kg). Approximately 900 kW hrs are required to dry the organic waste to a bio-fuel, 20 allowing for some thermal inefficiency, by evaporating approximately 450 kg of water. The resulting 550 kg of bio-fuel comprises approximately 500 kg of solid waste and 50 kg of water, i.e. approximately 10% water. The bio-fuel can generate 6 kW hrs per kg of bio-fuel. Thus, the 550 kg of 25 bio-fuel generates 3300 kW hrs of energy. Since 900 kW hrs were required in the heat exchanger to dry the food waste, the resulting energy output per tonne of food waste is 2400 kW.

CLAIMS

1. A method for drying organic waste, comprising the steps of:
 - 5 mixing and heating a first quantity of organic waste to form an organic powder;
converting a portion of the organic powder to heat a second quantity of organic waste.
- 10 2. A method according to claim 1, wherein the step of converting a portion of the organic powder comprises burning a portion of the organic powder.
- 15 3. A method according to claim 1 or claim 2 wherein the method is carried out as a step by step process.
4. A method according to claim 1 or claim 2 wherein the method is carried out as a continuous process.
- 20 5. A method according to any preceding claim wherein the organic waste has a water content of more than about 40% by weight.
- 25 6. A method according to any preceding claim wherein the organic powder has a water content of about 10% by weight.
7. Apparatus for drying organic waste comprising:
 - a vessel for mixing and heating a first quantity of organic waste to form an organic powder;

a conversion unit for converting a portion of the organic powder to generate heat for heating a second quantity of organic waste.

5 8. Apparatus according to claim 7 wherein the conversion unit is a combustion unit for burning a portion of the organic powder.

10 9. Apparatus according to claim 7 or claim 8 further comprising a heat exchanger, the heat exchanger using the heat generated by the conversion unit to heat the vessel.

10. Apparatus according to claim 9 wherein the heat exchanger circulates hot gas beneath the vessel.

15

11. Apparatus according to any one of claims 7 to 10 wherein the vessel comprises:

at least two elongate channels, each channel having a length and a substantially segment shaped cross-section;

20 and

an axle associated with each channel, each axle mounted for rotation about an axis parallel to the length of its respective channel, each axle mounting a plurality of mixing paddles or one or more helical blades.

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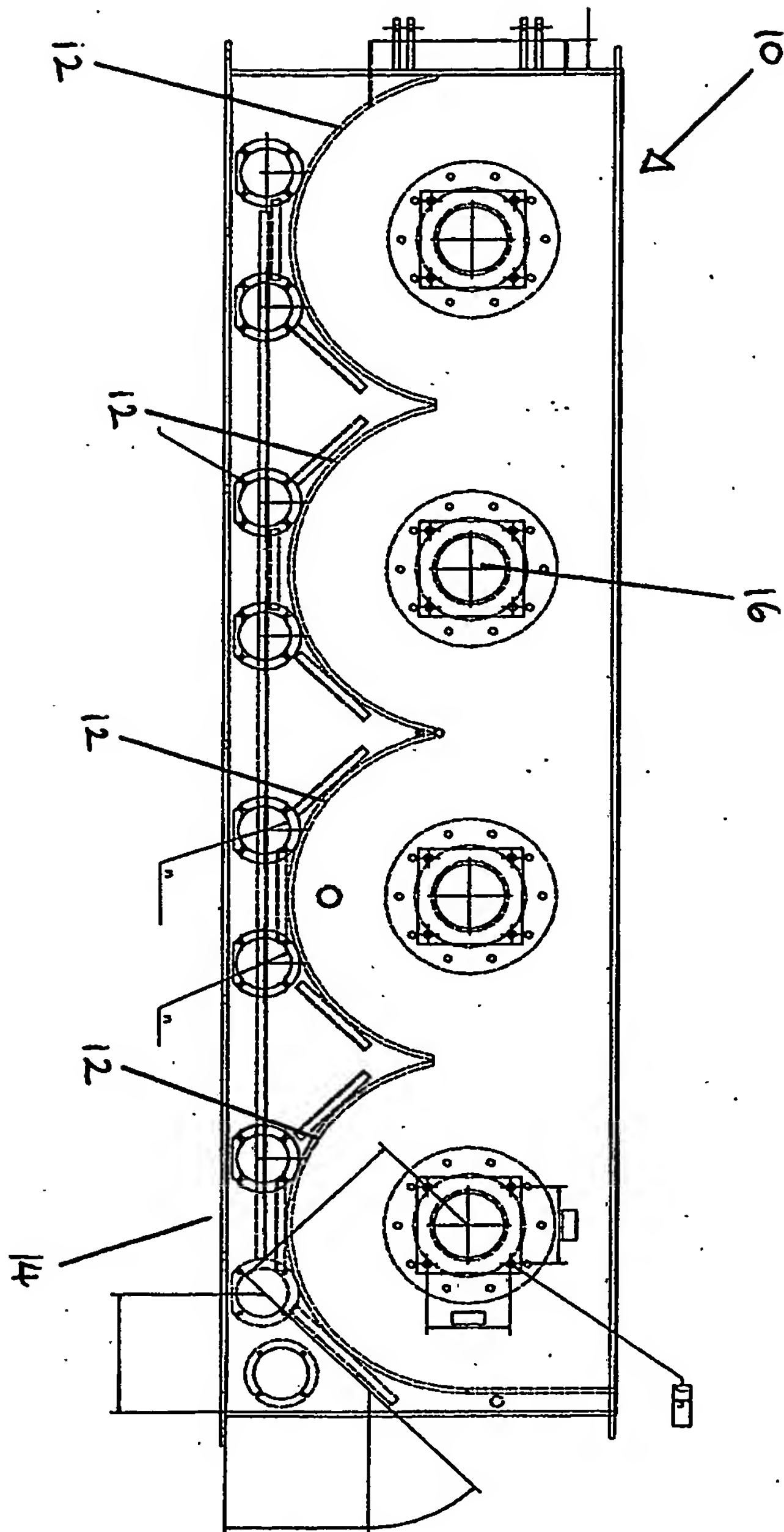
12. Apparatus according to any one of claims 7 to 11 wherein the organic waste has a water content of more than about 40% by weight.

13. Apparatus according to any one of claims 7 to 12 wherein the organic powder has a water content of about 10% by weight.

- 5 14. Apparatus for drying organic waste according to the method of any one of claims 1 to 6.

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FIGURE 1



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FIGURE 2

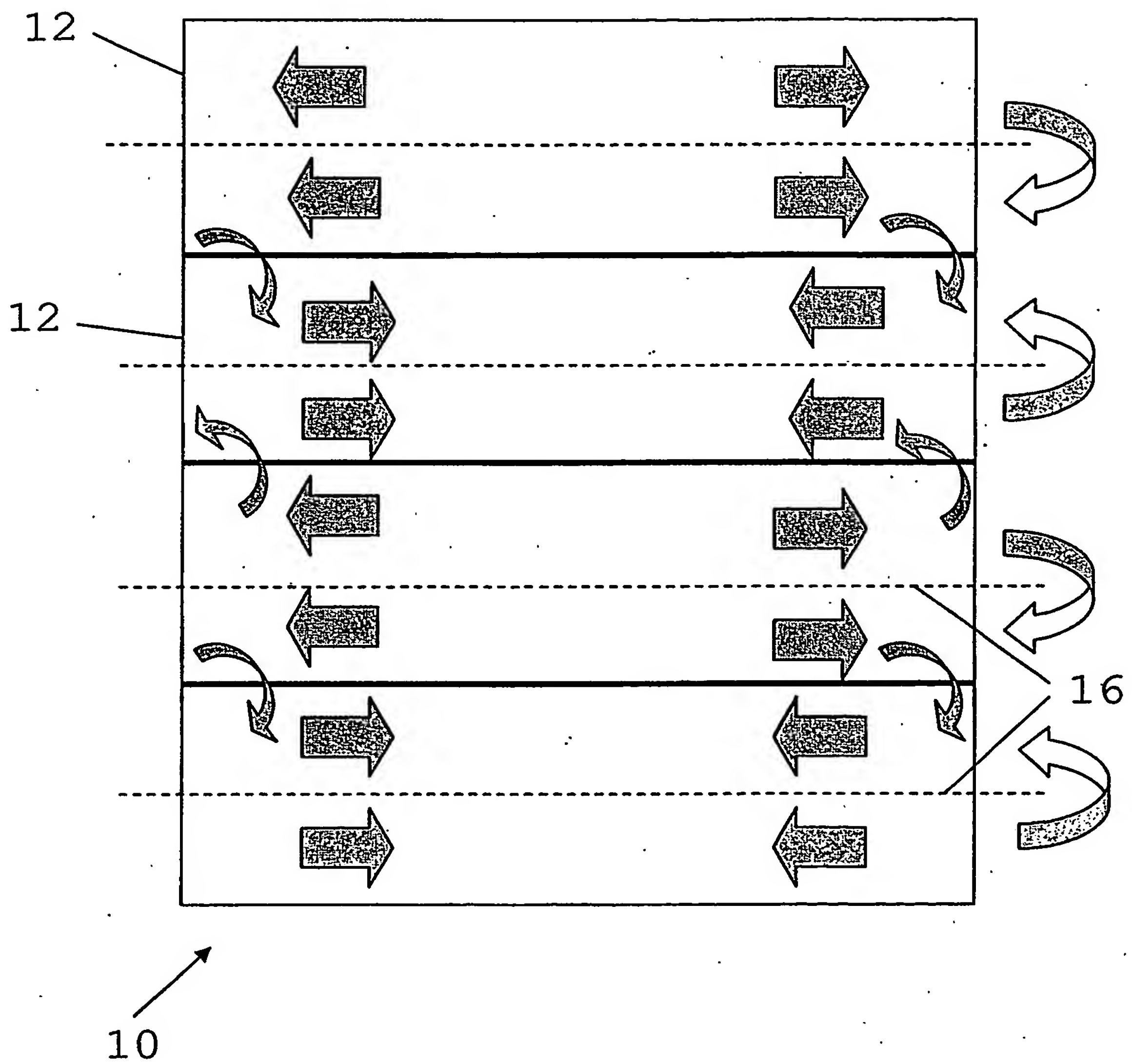


FIGURE 3

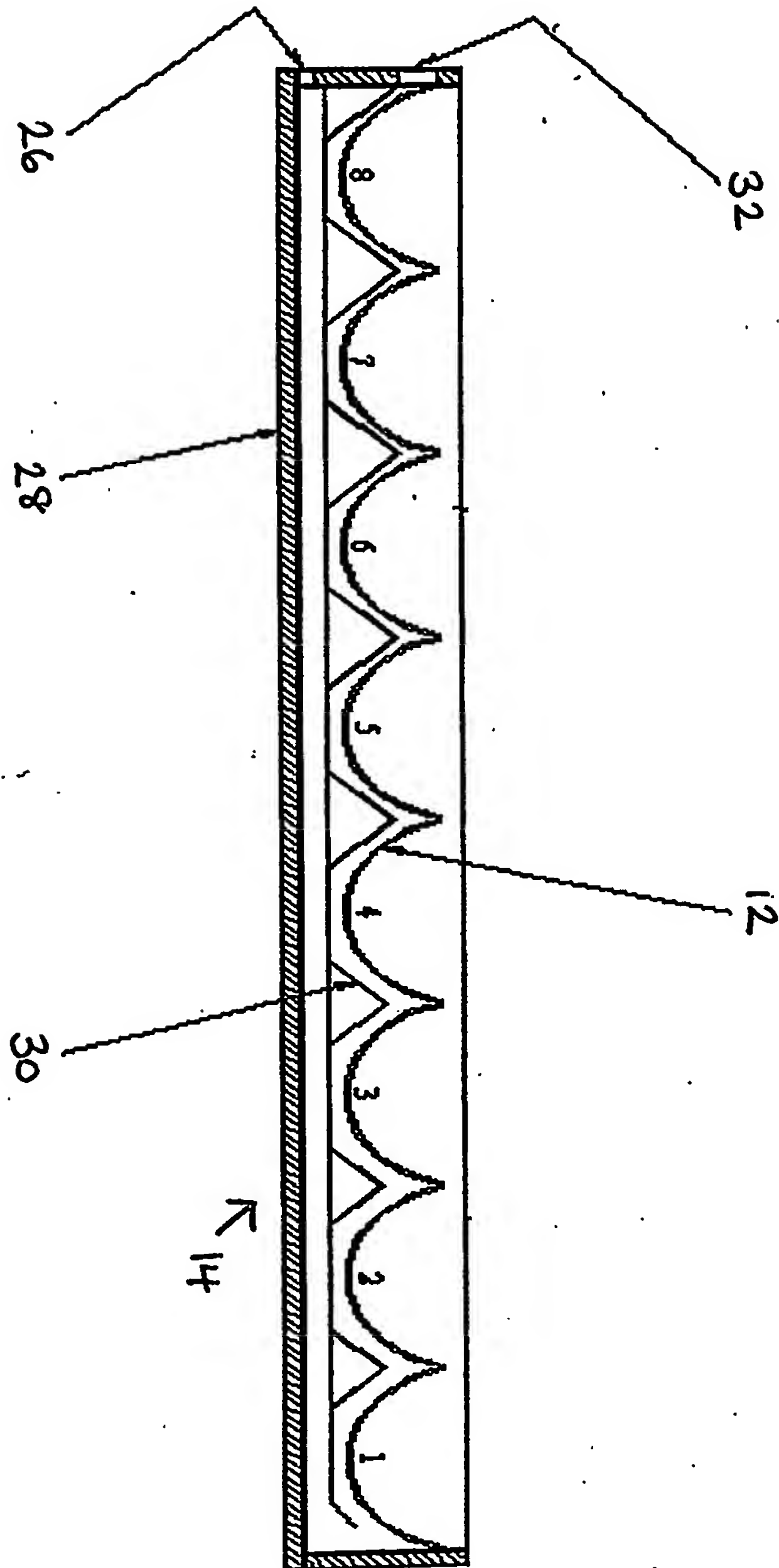


FIGURE 4

